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FACILITY FORM 802

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C. W. Stephens

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Monthly Progress Report for November 1961

EVALUATION OF REGENERATIVE FUEL CELL

Prepared for

Chief, Advanced Technology

Office of Space Flight Programs

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Contract NAS 7-71

EOS Report 1584-M-8

20 December 1961

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FACILITY FORM 602

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Contract NAS 7-7

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## 1. PROGRESS DURING MONTH OF NOVEMBER

Charge retention tests were continued and another life cycle test was initiated. The oxygen electrode studies have revealed three promising types of electrodes in addition to the currently employed platinized nickel. One element of the multicell unit was machined and tested. Polarization data was obtained for series operation of two cells and for a single cell under three different geometric orientations.

### 1.1 Charge Retention

One of the cells now in its 15th day of a special 30 day room temperature charge retention test has been found to effectively retain its charge as indicated by a very minute decline in gas pressure and a constant open circuit voltage of 1.02 volts. During the 15 days the oxygen pressure has been constant at 82 psig while the hydrogen pressure has dropped from 86 to 84 psig.

### 1.2 Life Cycle Tests

A cycle life test was conducted for the 33-35 minute cycle. After 417 cycles, the discharge voltage dropped to zero. No conclusion has yet been reached regarding the cause of voltage loss.

Another cycle life test employing a much larger percentage of cell capacity than the above was initiated and is currently in the 10th day of semicontinuous operation. The cycle consists of a 1 hr charge at 1.0 amp and a 5 hr discharge at 0.2 amp. One such cycle is carried out per day. To date the gas pressures and cell voltage have been found to be identical from cycle to cycle.

### 1.3 Oxygen Electrode Studies

The oxygen electrode studies have revealed two types of platinized carbon electrodes which exhibit polarization approximately equal to that of the currently employed platinized nickel. The first type was platinized by the method described by Hunger (USASRDL Technical Report 2001). The second was platinized by the spreading of a thin layer of platinum black over one surface.

Another special oxygen electrode from a battery supplier was found to exhibit appreciably less polarization than any which have been evaluated to date. More information on this electrode will be given at a later date.

#### 1.4 Series Operation

Two of the cells were operated in series at room temperature. The series performance was identical to that which can be expected from series operation of any type of cells. A typical operating point on discharge was 0.21 amps at 1.5 volts.

#### 1.5 Effect of Gravity

One cell was operated in three different geometric orientations in order to observe the effect of gravity on performance. In each orientation the cell operating characteristics were found to be identical. Hence, the cell performance appears to be independent of gravity.

#### 1.6 Multicell Unit

Testing of one element of the 9 cell unit was carried out at room temperature. The discharge polarization data for this element with 4" dia electrodes is given below:

<u>Volts</u>	<u>Amps</u>
1.10	0
0.92	0.1
0.86	0.4
0.72	1.0
0.64	1.5

Although the above polarization characteristics meet the original estimates, some gas leakage both external and internal was found to be present. In order to eliminate the leakage problems, dimensional changes in the "O" ring seals will be made.

2. PLANS FOR DECEMBER

- a. Modify the "O" ring seals on the multicell element and test for gas tightness
- b. Obtain cycling data on multicell element
- c. Continue investigation of causes for voltage loss giving special emphasis to the possibilities of  $O_2$  electrodes deterioration, flooding, or gas mixing brought about by high pressure differentials
- d. Obtain cycling data on best electrodes other than platinized nickel
- e. Complete 30 day charge retention test
- f. Continue charge retention tests at higher temperature according to the method employed in Sec. 1.1, i.e., measuring gas pressures versus time.